R·I·T	Title: PE 4400
Semiconductor & Microsystems	
Fabrication Laboratory	**Revision**: G	**Rev Date: 12/05/2012**

Approved by:

_____ / /   _____ / /
  Process Engineer   Equipment Engineer

1   SCOPE

The purpose of this document is to detail the use of the PE4400. All users are expected to have read and understood this document. It is not a substitute for in-person training on the system and is not sufficient to qualify a user on the system. Failure to follow guidelines in this document may result in loss of privileges.

2   REFERENCE DOCUMENTS

- o Material Safety Data Sheets for Argon, Oxygen, Nitrogen and metal targets.
- o Appropriate Tool Manuals

3   DEFINITIONS

n/a

4   TOOLS AND MATERIALS

4.1   General Description- The PE4400 is a load-locked RF sputtering system that sputters down and also has sputter etch capability. Various sized substrates may be used.

5   SAFETY PRECAUTIONS

5.1   **Hazards to the Operator**

5.1.1   **Voltage** – The PE4400 employs AC, DC and RF energies that are dangerous and may be fatal to personnel. Do not attempt to defeat protective interlock systems.

5.1.2   **Compressed Gases** – The PE4400 is operated with compressed gases. Do not attempt to defeat protective interlock systems. Evacuate the area immediately if the presence of these gases is suspected and notify SMFL staff member.

5.1.3   **Mechanical Hazards** – Drive assemblies have sufficient power to cause injury. Keep hands, fingers, clothing and tools clear of moving parts.

5.2　**Hazards to the Tool**

5.2.1　Excessive Power – Do not run above 1000W.

5.2.2　Tuning – Be sure to tune down the reflected power.

6　INSTRUCTIONS

6.1　**Initial State Check**

6.1.1　Swipe into the PE-4400 on the card swipe. DO NOT swipe out until your process is completed. If you do, you will have to bring your wafers back to the load chamber, open the lid and raise the platen to restart.

6.1.2　In Service Chase 2705, open the **PE4400 N2** valve.

6.1.3　In Service Chase 2705, the **CTI Cryogenic Compressor** should always be ON.

6.1.4　In Service Chase 2705, verify that the O_2 and Ar are on. Verify there is enough pressure in the bottle.

6.1.5　The **HX-150 Chiller** (located left of tool) should always be ON and set to 20C.

6.1.6　On the **PE 4400**, check the base pressure on the **Vacuum Gauge Controller**.

　　　6.1.6.1 If the **On** button and **IG1** are not illuminated, turn them on and wait for the reading to stabilize. The ion tube should be on and can be seen down between the chamber and the top of the tool.

6.1.7　On the PE 4400 **Process Pressure Control** panel, verify that the **MKS 652 Controller** is on.

　　　6.1.7.1 The Stop LED should be lit.

　　　6.1.7.2 The Pressure should display approximately 0 mTorr.

　　　6.1.7.3 The Position should be 90.0 Deg.

6.1.8　On the PE 4400 **Process Gas Control** panel, the **MKS 247 CONTROLLER** power should be **Off**.

6.1.9　On the PE 4400 **Process Gas Control** panel, the flow switches should all be **Off**.

6.1.10 On the PE 4400 **Ultek Lock Control**, the key switch should be in **Auto**.

    6.1.10.1   All manual switches in the **DOWN** position.

    6.1.10.2   The following LED's should be lit:

        HI-VAC VALVE
        LOAD
        CLOSED
        CARRIER OUT
        LOADED

6.1.11 On the PE 4400 **Auto Pumpdown Control**, the key switch should be in **Auto.**

    6.1.11.1   The **HI-VAC PUMP** switch should be **up**.

    6.1.11.2   The **MECH PUMP** switch should be **up**.

    6.1.11.3   All other switches should be **down**.

    6.1.11.4   The following LED's should be lit.

        HI-VAC PUMP
        HI-VAC VALVE
        MECH PUMP
        TRIP

6.1.12 IF THE TOOL IS NOT IN THE STATE AS LISTED IN SEC. 6.1 CONTACT A STAFF MEMBER.

6.2 **Wafer Loading (Wafer Platen is stored in the process chamber)**

6.2.1 On the **Power Control Panel** using the **Mode Selector** switch, select **Sputter Deposition** or tool will not transfer the platen.

6.2.2 Record the starting pressure from the **Vacuum Gauge Controller** in your lab notebook.

6.2.3 Turn off **IG1** and the **Vacuum Gauge Controller** by pressing **IG1** and **On**. The screen will turn off.

6.2.4   On the **ULTEK LOCK CONTROL** press and hold both the **START and UNLOAD** buttons simultaneously. The Load Chamber will pump down, the platen will move into the Load Chamber and the Load chamber will vent. (When this is done the Rough Valve LED will come on; it will go off after some time).

6.2.5   Once the Load Lock **ATM** light is lit (below load lock cover), press and hold BOTH **LOCK COVER** switches up until the Load Lock lid is fully raised and the pedestal raises with the platen.

6.2.6   Load your wafers with the flats facing out toward the outer edge of the platen and fill all empty slots with Silicon "dummy" wafers.

6.2.6.1 **NOTE**: One slot on the platen is warped and results in a non-uniform coating. This location is noted by two X-marks etched in the platen to the left and right of the metal washer used to hold the wafer in place. Place a dummy wafer in this slot, or leave it empty.

6.2.7   Press and hold BOTH LOCK COVER switches down to lower the lid. **Danger: The Load Lock Lid assembly does not have a cutoff switch and will crush whatever is in its path as long as the switches are depressed.**

6.2.7.6 After the lid starts to lower, the platen will lower and the LOAD light will come on.

6.2.7.7 The platen will automatically load into the process chamber.

6.2.7.8 The **LOADED** light on Ultek Lock Control will come on when completed (this will take about 12 minutes)

6.2.8   Turn the **Vacuum Gauge Controller** on by pressing **ON** and then **IG1**. The ion tube should be on and can be seen down between the chamber and the top of the tool.

6.2.8.6 The display should read lower than 5.0 x 10 E-5 and drop relatively fast.

6.2.8.7 **DO NOT EXPECT** a lower pressure than when you first came up to the tool. You are adding "contamination" to the vacuum system and it will take hours to remove it.

6.3   **Sputter Deposition or Etch**

6.3.1   On the **Power Control Panel** using the **Mode Selector** switch, select either **Sputter Deposition** or **Sputter Etch**.

6.3.2   Select the appropriate target or etch mode using the **TARGET SELECTOR** switch.

6.3.3   Leave the **BIAS ADJUST** pot set to 0 ZERO.

6.3.4   The **SHUTTER POSITION** switch set to **OPEN**

6.3.5   SMFL staff will do 10 min Target burn-ins after chamber maintenance or target changes are completed on all 3 targets.

6.3.6   *After the required base pressure has been reached*, turn **off** the **Vacuum Gauge Controller** by pressing **IG1** and **On**. The screen will turn off.

6.3.7   Verify that the Ion Tube is no longer glowing.

6.3.8   On the **AUTO PUMPDOWN CONTROL**, push the **START** and **GAS** buttons simultaneously. The Platen will start rotating and the following lights should now be lit:

Gas Valve
Throttle Valve
Hi-Vac. Pump
Hi-Vac. Valve
Mech. Pump
Gas (Mode)
TRIP

6.3.9   Platen speed can be adjusted with the Table Rotation Speed Control. (A setting of 200 should give approximately 6 RPM).

6.3.10 On the **MASTER GAS CONTROL** - Set the switches for your gases to the **UP/OPEN** position.

6.3.11 Turn on the **MKS 247 C** - Set the gases you want to flow to the **ON** position. Allow a minute for gas flows to stabilize.

6.3.12 On the **MKS 652**, select your desired process pressure with the appropriate button and allow pressure to stabilize. When the **"Deg :"** stops moving, pressure is stable. There is a 0.3mTorr drift in the pressure reading.
      Button **A** = variable (change as needed for specific requirements)
      Button **B** = 2mTorr
      Button **C** = 3mTorr
      Button **D** = 4mTorr
      Button **E** = 5mTorr

6.3.13 On the **ENI Controller** make sure the AC Line breaker is on.

6.3.14 Adjust power knob on ENI controller to (393 ≈ 500W), (692 ≈900W) or other value.

6.3.15 Dim lights in bay so that plasma will be visible.

6.3.16 Turn **on** the **RF Power** and instantly press and hold **Filament Igniter** button on the process pressure control panel. Look in the chamber window to see if plasma is glowing (purple in color). Remember to start your process timer.

6.3.17 Check the reflected power on the **ENI supply**. Reflected power should read less than 10% of forward power. Adjust if needed. Contact technician for issues with reflected power.

6.3.18 Do not leave the tool unattended while running process since the gas flows and RF power will NOT shut off when process time is completed.

6.3.19 At the end of the sputter time turn RF power on ENI controller to OFF / Remote.

6.3.20 On the **Process Gas Control** panel, turn off the gas flows on the MKS 247, and then turn off the power to the MKS 247.

6.3.21 On the **MASTER GAS CONTROL** - Set the switches for your gases to the **Down/Closed** position.

6.3.22 On the **MKS 652** Gauge, press the **OPEN** button to open the Throttle Valve. The open LED will be lit.

6.3.23 When the display reads about 0 mTorr and the position is 90 Degrees, press the **STOP** button to ensure that the motor does not continue to drive.

6.4   WAFER UNLOADING

6.4.1   On the **Power Control Panel** using the **Mode Selector** switch, select **Sputter Deposition** or tool will not transfer the platen

6.4.2   On the **AUTO PUMPDOWN CONTROL**, push the START and PUMP buttons simultaneously. This will stop gas flow to the Process Chamber. The following LED's should be lit.

HI-VAC PUMP
HI-VAC VALVE
MECH PUMP
TRIP

6.4.3   On the **ULTEK LOCK CONTROL** press and hold both the **START and UNLOAD** buttons**.** Wait about 5 minutes for the Load Chamber to pump down, the platen to move into the Load Chamber and the Load chamber to vent.

6.4.4   Once the Load Lock **ATM** light is lit press and hold **BOTH LOCK COVER** switches up until the Load Lock lid is fully raised and the pedestal raises with the platen.

6.4.5   Unload your wafers.

6.4.6   If you are doing another run, load your next set of wafers now and return to Section 6.2.6 of this manual.

6.4.7   Press and hold BOTH **LOCK COVER** switches down. The lid will lower and the **LOAD** light will come on. The platen will lower before the lid contacts it and will automatically load into the process chamber.

6.4.8   After the **LOADED** light comes on (**Ultek Lock Control**), turn on the **Vacuum Gauge Controller** and **IG1**. The tube will be glowing.

6.5   TOOL SHUT DOWN

6.5.1   On the **MKS 652** Gauge, the position should already be 90 Degrees and the stop button should have been previously pressed.

6.5.2   Make sure the **MKS 247 Controller** is **off**. Make sure all gas controls are OFF.

6.5.3   On the **Master gas control**, make sure all of the switches are in the **down/off** position.

6.5.4   Swipe out of the tool.

REVISION RECORD

Summary of Changes	Originator	Rev/Date
Original Issue	John Nash	A-02-17-2009
Randex RF supply was replaced with ENI	John Nash	B-10-29-2009
Updated format and clarified some areas	O'Brien	C-11/30/2009
Added 6.2.1 and 6.4.1. Updated 6.3.16.	Kelly Johnson	D-10/20/2010
Updated 6.2.6.1 to note warped platen slot	Kelly Johnson	E-01/17/2011
6.1.6, 6.2.2, 6.2.3, 6.2.8, 6.3.6, 6.4.8 modified to include Vacuum Gauge Controller, 6.3.13-6.3.17 modified to improve ENI supply instructions	O'Brien	F-09/22/2011
Clarified 6.3.20 and 6.3.21. Added 6.3.22 and 6.3.23. Section 6.5 modified to reflect changes to 6.3.22 and 6.3.23.	Sean O'Brien	G-12-5-2012

This pump down data was done after a fresh cryo regen and the chamber pumping for 24 hours

TIME	Pressure (Platen In)	Pressure (Platen Out)
Base Pressure	3.8 x10 E-7	3.8x10 E-7
Load Lock Door open	1.0 x 10 E-5	1.0 x 10 E-5
Load Lock Door closed	2.3 x 10 E-6	1.2 x 10 E-6
2 min	1.0 x 10 E-6	5.6 x 10 E-7
4 min	8.6 x 10 E-7	4.4 x 10 E-7
6 min	7.7 x 10 E-7	4.0 x 10 E-7
8 min	6.9 x 10 E-7	3.9 x 10 E-7
10 min	6.4 x 10 E-7	3.8 x 10 E-7
12 min	6.0 x 10 E-7	
14 min	5.8 x 10 E-7	
16 min	5.5 x 10 E-7	
18 min	5.4 x 10 E-7	
20min	5.2 x 10 E-7	
22min	5.1 x 10 E-7	
24min	5.0 x 10 E-7	
26min	4.9 x 10 E-7	
28min	4.8 x 10 E-7	
30 min	4.8 x 10 E-7	
32 min	4.7 x 10 E-7	
34 min	4.7 x 10 E-7	
36 min	4.6 x 10 E-7	
38 min	4.6 x 10 E-7	
40 min	4.5 x 10 E-7	
42 min	4.5 x 10 E-7	
44 min	4.5 x 10 E-7	
46 min	4.5 x 10 E-7	
48 min	4.4 x 10 E-7	
50 min	4.4 x 10 E-7	
52 min	4.4 x 10 E-7	
54 min	4.4 x 10 E-7	
56 min	4.3 x 10 E-7	
58 min	4.3 x 10 E-7	
60 min	4.3 x 10 E-7	